

DEVELOPMENTS IN SOVIET INDUSTRY

25. Soviet total industrial production approximately doubled during the period 1948-1954, and increased ^{about} /nine percent during 1954.

The current and apparent long-run objectives and limitations of Soviet industrial production indicate that the average annual real rate of increase during 1955-1960 will be over seven percent, and production in 1960 will be about 55 percent greater than in 1954. The substantial and continuing decline in the estimated rate of growth of industrial output is essentially attributable to:

(a) a reduction in the rate of growth of the industrial labor force; and (b) a reduction in the average yield of annual additions to industrial investment. The greatest production increases during the 1955-1960 period are expected to occur in chemicals, electric power, electrical equipment, and manufactured consumer goods. The smallest production increases are expected in the more established industries with relatively large current production, namely, manufactured food products, forest products, and defense industries.

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Table 1

Estimated Soviet Industrial Production, Selected Years 1948-1960^{1/}

Indexes: 1954=100

	<u>1948</u>	<u>1953</u>	<u>1954</u>	<u>1955</u>	<u>1960</u>
Energy	52	91	100	111	172
Metals	45	90	100	108	146
Metalworking & Machinery	41	88	100	114	169
Chemicals	45	88	100	111	172
Construction Materials	39	88	100	111	172
Forest Products	66	91	100	103	124
Food Products	63	96	100	104	134
Manufactured Consumer Goods	45	90	100	115	169
Defense Industry	36	102	100	113	122-132 ^{2/}
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Total Industry	49	92	100	110	155

1/ The 1955-1960 estimates are projected from recent rates of growth, current investment programs, and such Soviet plans as have been announced for this period.

2/ The lower figure--122--is calculated on the assumption that during the period of this estimate there will be some reduction of present levels of production of some military end-items (see paragraph 75). The larger figure--132--assumes that present production remains approximately constant, and that new weapons and equipment programs are added. It should be noted that the estimated cost of the Soviet atomic energy program is not included in the figures for defense industry.

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26. Soviet heavy industrial production has been increasing at an average annual rate of over 10 percent during the current Fifth Five-Year Plan. Official announcements indicate that production plans for most nonferrous metals, petroleum, and certain capital equipment are not being met, but that the over-all plan for heavy industry is generally being met. Production of capital equipment for light and processing industries has almost certainly exceeded the original Fifth Five-Year Plan. Heavy industry will almost certainly continue to dominate industrial production plans for the 1955-1960 period, although more attention will probably be devoted to housing and nonindustrial construction than in the last six years.

27. Soviet armaments production almost doubled in value (though not in volume) between 1950 and 1954. US expenditures for military end-items, although less than Soviet expenditures during the period 1946-1950, increased rapidly after 1951, reached a high in 1953, and have since slightly decreased. In terms of what Soviet armaments would have cost at US quantity-production prices, we estimate that the aggregate dollar value of Soviet military

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production in 1951 was roughly 50 percent more than the dollar value of US armament deliveries, whereas in 1954 the aggregate dollar value of Soviet military production would have amounted to a little less than half that of US armament deliveries. The value of Soviet military end-item production will probably increase by a moderate amount annually through the period of this estimate, assuming no significant change in the level of international tensions. There will be some shift in the relative outlay for various types of weapons, in particular an increase in expenditures for aircraft and naval vessels, and perhaps for nuclear weapons and guided missiles. We believe that it is within Soviet capacity to increase present and estimated future outlays by three to three and a half times in the event of war or international developments which the Soviet leaders might believe required such increases.

28. The output of consumer goods and services in 1954 exceeded that of 1953 by about seven percent, increasing at about the same rate as GNP, but at a slower rate than gross industrial production and at about two-thirds the rate of heavy industry. Durable consumer goods, housing and appliances led the advance, followed in order by clothing, transport, and other services. Production of

food was limited by continuing agricultural difficulties, and increased only about four percent. Production of consumer goods is expected to continue to increase during the 1955-1960 period, although at a lower average rate than in 1954.

29. The announced Soviet intention to re-emphasize heavy industry will have the effect of arresting the 1953-1954 rates of increase in light industry, but will still permit some improvement in the position of the Soviet consumer. Increased emphasis on agriculture will probably provide an expanding output. Agricultural products are the material base for more than 80 percent of the Soviet consumption pattern. Maintenance of capital investment in both light industry and housing at levels well above those of the 1953 plan lends further support to the estimate that the Soviet consumer will not be deprived of the gains obtained in 1953-1954. The 1955 increases in military production, however, may have the effect of slowing down increases in the production of durable consumer goods.

30. Industrial Technology. The quality of Soviet industrial technology as a whole is difficult to assess. Where a particular program has been indispensable to the maintenance of the Soviet power position in the world -- for example, in connection with atomic development, in weapons, and in basic industry and construction -- the USSR has mobilized its technical resources with great effectiveness. Because of the large number of personnel, and the material and financial

outlays required for such technical developments, major efforts such as these have taken a great share of the limited resources the USSR can devote to improving its technology. Soviet technology in lower priority enterprises ranges from the copying of Western design and technique in certain machine industries to admittedly archaic methods of production in a vast majority of light industry establishments. In many of the latter, efforts are made to reduce production costs, but these are largely local efforts made by plant workers and managers who have relatively little training and experience.

31. Regional Concentrations. The regional distribution of industrial production shows the impact of Soviet efforts to achieve greater balance between the several economic regions of the USSR, and to make these regions as far as possible self-sufficient. However, production continues to be relatively concentrated in the long established industrial regions of northwest, center, and south. (See Figure 3) The rapid prewar development of the Ural industrial complex based upon West Siberian coal has continued in the postwar period, and the Urals now produce some 14 percent of Soviet industrial output, compared to 16 and 27 percent respectively in the Ukraine and the Central Industrial region (including Moscow). Although industrial production east of the Urals has grown rapidly since World War II, the base from which it grew was small and much of the production is highly specialized and dependent upon equipment and markets in other regions to the west.

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32. Stockpiling. There was some evidence that during 1953-1954 Soviet reserve stocks were drawn upon more freely than previously. The scale of stockpiling operations during these years indicates that the Soviet stockpile will fail to meet the 100 percent expansion planned for 1951-1955. However, Bulganin's February 1955 speech gives evidence that the USSR intends to apply renewed emphasis to the stockpile program and to restrict the conditions under which stockpiles may be used to support current production programs. An increase in the scale of the stockpiling program may deprive Soviet industry and Soviet consumers of a portion of the increased flow of goods which would be expected from increased production.

33. Transportation. The transport facilities of the USSR continued to increase ton-miles of freight at a rate well in advance of that required by the Fifth Five-Year Plan. ^{The} /increase in rail freight turnover at the end of 1954 was 42 percent over 1950, compared to an increase of only 35-40 percent planned for the period through 1955. These figures suggest that Soviet planners may have underestimated the transport requirements of their rapidly expanding economy. A rate of investment higher than previously planned will apparently be necessary

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to permit Soviet transport to maintain growth necessary to support the future expansion of the economy. Highway and waterway freight carriage have also increased rapidly in recent years but not at a rate which will reduce the primary dependence of the economy upon rail transport, *particularly in the areas served by the Trans Siberian Railway.*

34. Labor Force. A large proportion of the recent growth in Soviet industrial output has been achieved by increasing the size of the industrial labor force rather than by increasing its efficiency. The 1951-1955 plan for increases in the non-^{agricultural} labor force was fulfilled by 1953. Planned increases in agricultural production -- particularly in livestock and corn, both of which are labor intensive items -- and a significant reduction of the annual rate of entry into the labor force during 1955-1960 will deny industrial production a labor force growth during this period comparable to that obtained in the preceding period. (See Table 2) In addition to the labor requirements for agriculture, rates of increase in the industrial labor force will decline primarily because of the effects of the low birth rate during World War II.

Table 2

Estimated Labor Force of the USSR, 1938, 1947-1956, Projected to 1960
Yearly Averages in Millions of Workers

	<u>Agriculture</u>	<u>Non-Agriculture</u>	<u>Total Excluding Military and Forced Labor</u>	<u>Total* Labor Force</u>
1938	53.3	25.7	79.0	90.3
1947	54.4	30.0	84.4	97.0
1948	53.8	31.0	84.8	98.0
1949	53.1	32.0	85.1 86.0	98.0
1950	52.6	34.6	87.2	99.0
1951	51.8	36.2	88.0	100.0
1952	51.0	37.8	88.8	101.5
1953	51.8	38.1	89.9	101.5
1954	52.7	40.3	93.0	104.2
1955	54.1	41.6	95.7	106.5
1960	56.3	46.6	102.9	112.3

* Total labor force estimates are subject to a considerable margin of error because of lack of data on the amount of forced labor.

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35. A similar decline in the rate of entry to the military manpower pool may be expected. The decline in the annual entries into the industrial labor force in this period will require continued emphasis on measures to increase the productivity of labor. The trend since 1948 of declining annual rates of increase in labor productivity was arrested in 1954. Maintenance of high levels of capital investment and reasonably improved per capita consumption levels --- factors which are considered critical to Soviet labor productivity -- therefore become essential to the achievement of the estimated rates of over-all industrial and economic growth.

DEVELOPMENTS IN SOVIET AGRICULTURE

36. Soviet agriculture completed its first full crop year under the new agricultural program in 1954. It became clear: (a) that the Soviet leaders were seriously intent upon increasing agricultural production; (b) that the incentives contemplated in the 1953 program had so far done little to improve rural productive effort; and (c) that there had been an increase in the size of the agricultural labor force and some improvement in the quality of technical personnel. Owing in part to adverse weather conditions, 1954 agricultural output ^{probably} increased, ^{but} only about three percent, and did not reach 1952 production levels. (See Table 3)

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Table 3

Estimates Production of Major Crops in the USSR
1938 and 1950-1955

	<u>1938</u>	<u>1950</u>	<u>1951</u>	<u>1952</u>	<u>1953</u>	<u>1954</u>	<u>1955</u>
<u>Food Crops</u> Million Metric Tons							
Grain	88.6	85.0	80.0	92.0	83.0	87.0	---
Potatoes	73.8 ^{*/}	72.3	59.5	69.7	66.4	67.2	---
<u>Fiber Crops</u> Thousand Metric Tons							
Cotton (Ginned)	730	1,140	1,220	1,260	1,300	1,410	---
Flax (Scutched Basis)	600	540	480	400	350	400	---
Wool (Grease Basis)	130	190	205	225	230	235	---
<u>Animal Crops</u> Million head 1 Jan.							
Cattle	59.2	----	57.2	58.8	56.0	57.7	57.6
Pwine	31.6	----	24.1	26.7	28.5	29.6	31.8
Sheep & goats	73.1	----	99.0	107.5	109.9	112.0	114.7

*/ 1933-1937 average.

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The 1954 increase was achieved largely as a result of favorable growing conditions in the "new lands," since a severe drought struck the principal producing regions in the Ukraine and Volga. On the other hand, agricultural investment/increased almost 40 percent, in part by using the increased income of collective farms and also by large increases in state budget allocations. Crop acreage increased by six percent as a result of over-fulfillment of the "new lands" program. A return to average weather conditions/ throughout the USSR during 1955 would result in a sharp increase in agricultural output.

37. Both 1954 and early 1955 saw additional changes in the 1953 agricultural program, all of which aimed at further expansion of output. The new lands program, which is to add to the cultivated acreage of the USSR an amount of land equal to the total cultivated acreage of Canada, moved forward ahead of schedule and with favorable crop yields in 1954. The early 1955 announcements outline what is apparently the essence of the Sixth Five-Year Plan for agriculture, and despite the failure of the current plan, they establish a series of agricultural goals for 1956-1960 which are even more ambitious than those set forth in the Fifth Five-Year Plan. (See Table 4)

Table 4

Officially Planned Output Goals for Soviet Agriculture

	<u>1960</u>
	Index: 1954=100
Meat	200
Milk	200
Eggs	200
Wool	180
Grain	188*

* This is estimated from the officially announced goal of "not less than" 164 million tons by 1960, and the estimated output of 87 million tons in 1954.

Meat and dairy products, both very costly to produce, constitute the major objectives of the 1960 plan. To achieve the vast growth in animal production, the USSR has embarked on a large-scale program to get an eight-fold increase in corn acreage. The Kremlin has also increased local control over agricultural production and has undertaken a large program to increase the stability and technical competence of the agricultural labor force. In April 1955 there was recruitment of some 30,000 managers, largely from Party ranks, who would replace roughly one-third of the existing collective farm managers.

38. While the measures announced in the fall of 1953 reflected a more realistic appraisal of material, natural, and human resources requirements, this cannot be said of the decrees on virgin land and corn production issued in 1954 and early 1955. A large part of the program approaches the climatic limits of economic production for the land and crops involved. Moreover, the strains and stresses engendered by these campaigns will probably slow up the otherwise possible rate of growth in the "old" regions. Thus the net results will almost certainly fall/^{far}short of plans, though there will probably be some increases in production and in state control over agricultural output.

39. The principal problems posed by the agricultural program are:

(a) the "new lands" scheme will draw many skilled people from established and more productive areas; (b) the combined "new lands" and corn and live-stock programs will require very large additional outlays for machinery, construction, and fertilizer, as well as labor; and (c) climatic conditions in the new lands areas are such as to produce frequent crop failures. Moreover, the apparent piecemeal manner in which the program has been instituted raises considerable doubt as to whether the above problems have been adequately assessed.

40. All Soviet agriculture operates under several inherent limitations. With few exceptions, the areas of adequate rainfall in the USSR are areas of poor soil and short growing seasons. Nearly all of the good soils lie in an

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area of uncertain or deficient rainfall. There are no areas in the USSR comparable to the US cotton belt or corn belt where soil, rainfall, and temperature are favorably combined over a large area to permit high production response with conventional inputs. Less than 10 percent of arable land in the USSR will yield more than modest increases in output without the addition of extremely large amounts of fertilizer and machinery. Significant increases on most of the arable land would require, in addition, even larger investments in drainage or irrigation. Apart from these natural limitations, the institutional structure of Soviet agriculture, while permitting effective political control over the peasant population, fails to achieve operating efficiency and continues to produce peasant antipathy.

41. In view of these limitations we estimate that, even with average weather conditions, agricultural production in 1960, instead of increasing by nearly 100 percent as planned, will actually increase by only 30 percent. (See Table 5)

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Table 5

Estimated Soviet Agricultural Production: An Index of
Ten Major Commodities*

1938-1960

1938	94
1948	80
1952	103
1953	97
1954	100
1955	109
1960	130

* Bread grain, coarse and other grains, potatoes, vegetables, meat, milk, cotton, wool, hemp, and flax.

Further extension of capital investment and labor might make possible additional growth in agricultural output, but such additions would result in a reduction in the average rate of growth for the economy as a whole.

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SOVIET CONSUMPTION LEVELS

42. Per capita Soviet consumption in 1954 rose somewhat more than 5 percent over the 1953 level, a rate of increase slightly higher than had been achieved in the first year of the revised consumer goods program. (see Table 6) Durable consumer goods other than housing showed the most rapid increase, about 20 percent on a per capita basis. Clothing and textile consumption increased about 10 percent and food consumption by only 2 percent. Per capita consumption of certain quality foods (whole milk) failed to increase and some (meat) even declined. Improvement in consumption in 1954, as in the period since 1950, was not uniform for all income groups, managers and skilled workers were the principal beneficiaries. Middle and lower income groups derived only negligible benefit from increased supplies of expensive fabrics and appliances. For most families in these income brackets, failure of food production to do much more than keep pace with population increases in a period of greater disposable income has meant longer queues, extra visits to the free market, and no improvement in real consumption.

Table 6

USSR: *Estimated* Indexes of Per Capita Consumption
1948-1960

1954 = 100

	<u>1948</u>	<u>1952</u>	<u>1953</u>	<u>1954</u>	<u>1955</u>	<u>1960</u>
Food Products	76	97	98	100	103	116
Clothing	50	82	91	100	112	153
Manufactured Consumer Goods	36	73	83	100	117	160
Transport and Communications	61	87	95	100	105	132
Housing	95	98	99	100	102	109
Urban	95	97	98	100	102	113
Rural	94	98	99	100	101	105
Other Services	89	95	97	100	102	117
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Total Consumer Goods and Services	69	90	95	100	106	129

43. Recent increases in real income through increased family income and price reductions have not been matched by commensurate increases in the production of consumer goods. Price reductions in 1954 yielded a negligible increase in the workers' food basket and failed, where preceding price cuts had succeeded, in reducing free market prices. The increased state loan in 1955 and the failure thus far in 1955 to provide the usual annual reduction in consumer goods prices is evidence of a desire to reduce inflationary pressures.

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44. We estimate that, given the probable rate of increase in Soviet agricultural production for 1955-1960, aggregate Soviet consumption will probably increase by about 30 percent during this period. However, food and housing, by far the major components for the average Soviet consumer, will increase by less than 20 percent. There were indications in late 1954 and early 1955 that some influential elements among Soviet planners were pressing for a higher rate of growth in consumption than that called for in the 1953 plan. Present agricultural plans indicate that the present Soviet leadership hopes to increase consumption at a more rapid rate than we have here estimated. However, the high cost of agricultural expansion and the competing demands of other sectors of the Soviet economy will probably combine to restrict a more rapid growth in Soviet consumption levels.

45. The disparity between rural and urban scales of living has grown more pronounced since the beginning of the Five-Year Plans. Exact quantification of this difference is exceedingly difficult because the greater part of rural consumption is consumption in kind, but the disparity probably exercises a substantial restraint upon peasant incentive and interest in agricultural output. Despite the fact that the peasants produce the major portion of the Soviet food supply, they eat less well than city people, even though their caloric intake is about equal. The city dweller consumes about

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50 percent more milk, two to three times as much meat, and appreciably more fish, vegetable oil, butter, eggs, and sugar. Housing quality is considerably better in the city although the average space per capita is greater in the country. An analysis of retail trade suggests that city people consume three to four times as much manufactured consumer goods as do rural consumers. The grossly inadequate rural transport and market systems will continue to restrict the ability of the Soviet government to eliminate private agricultural production in rural areas. They are also major blocks to the effective exercise of the increased peasant purchasing power which was intended to provide the incentive to support the new agricultural program.

DEVELOPMENTS IN SOVIET FOREIGN TRADE

46. Soviet foreign trade in 1954 increased almost 20 percent over the preceding year. The increase of \$1.1 billion represents the largest absolute volume increase since the period prior to the Korean War, and the highest trade level with the free world since before 1948. (See Tables 7 and 8) Total Soviet foreign trade has increased at a rate more than twice that of GNP; ^{the increase is} attributable mainly to growing trade within the Sino-Soviet Bloc. Trade with the free world has been increasing since the end of 1950 with the exception of 1953, but remains below prewar volume.

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Table 7

Estimated Foreign Trade Turnover in the USSR

Trading Area	<u>1951</u>		<u>1952</u>		<u>1953</u>		<u>1954</u>	
	Value	Percent	Value	Percent	Value	Percent	Value	Percent
Satellites (incl. Communist China)	3.6	80	4.1	80	4.9	86	5.6	82
Free World	0.9	20	1.0	20	0.8	14	1.2	18
Total Trade	4.5	100	5.1	100	5.7	100	6.8	100

Table 8

Volume Index of Soviet Trade Turnover
(1948=100)

<u>Year</u>	<u>With the Bloc</u>	<u>With the Free World</u>	<u>Total Foreign Trade</u>
1949	191	75	126
1950	347	64	189
1951	399	74	218
1952	464	92	256
1953	577	77	298
1954	690	114	359

47. Soviet trade with the free world was still primarily with Western Europe although there was a considerable increase in trade with less highly developed areas of the world. The usual export surplus with Western Europe declined slightly in 1954 and the USSR ran a large deficit with under-developed areas. It is estimated that the USSR ran a substantial commodity deficit with the free world; gold sales are estimated to have been \$100-150

millions in 1954. Traditional Soviet exports to the West have been limited by increases in internal Soviet consumption and by the substantial trade program within the Sino-Soviet Bloc; this program has recently included large shipments of grain from the USSR to the European Satellites, which, taken as a whole, were formerly a net grain-exporting area. Although

there was some increase in Soviet imports of consumer goods from the free world in 1954, there was little other change in the pattern of imports. Grain exports to the free world declined slightly from the postwar low in 1953, while exports of petroleum and other mineral and forest products increased. In late 1954 and early 1955 there ^{were} some indications that the USSR might decrease its imports from the West.

48. According to Soviet data foreign trade turnover with other Bloc nations increased (in value) about 14 percent in 1954, compared to a 50 percent increase with the West. Inasmuch as there was little change in the

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estimated volume or composition of Sino-Soviet trade, most of the increase in Bloc trade probably took place between the USSR and the European Satellites. The USSR apparently serves as an intermediary for much of intra-Bloc trade, and in part for this reason it is difficult to ascertain the real volume of increase in trade among the various members.

49. Soviet technical assistance programs within the Bloc continued to constitute an integral part of Soviet political and economic control. There was a further increase in the intensity of Soviet propaganda and *in* negotiations to extend the area of technical assistance to non-Bloc countries, particularly to underdeveloped countries of Asia. For the first time, there were actual movements of technicians and equipment (into Afghanistan) and a contract for the construction of a steel mill in India was signed early in 1955. More overtures like these will ~~be~~ *be* probably made as the Soviet economy grows, especially if the USSR does not substantially increase the scale of its military effort.

50. The 1955-1960 pattern of Soviet foreign trade will be subject to so many conflicting factors that any forecast must be conditioned by possible changes in the international climate and in the respective capabilities of the trading partners. The USSR is still sufficiently

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behind Western technology to have a continuing need for Western capital equipment. Although Soviet food supply is adequate for the immediate future, failure to increase present agricultural production would eventually lead to additional requirements for food products from outside the Bloc. The USSR has the capability at present to expand export of certain raw materials and is rapidly approaching a position in which it could export a substantial volume of manufactured goods and capital equipment. Thus the capability for an increase in trade with the West exists.

51. Soviet programs and policies, however, will probably preclude any rapid expansion of trade with the West, and will probably confine any increase in this trade to a level approximating over-all Soviet economic growth. The level of trade within the Bloc will continue to increase, but at a somewhat lower rate than in the recent past. The amount of trade within the Bloc would be greatly increased if the USSR encouraged a greater degree of national specialization among the Bloc states. We believe it more likely that the USSR will maintain a Bloc-wide division of labor not much changed from the present structure and will continue to restrict trade between its associates and the free world.

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IV. SCIENTIFIC AND TECHNICAL DEVELOPMENTS

MAGNITUDE OF SCIENTIFIC ASSETS -- POLICY AND PRIORITIES

52. The USSR has consistently given strong support to the development of science and technology. As a consequence, Soviet scientific and technical capabilities have increased at a rapid pace, especially since World War II. We believe that these capabilities will increase throughout this period, and will continue to provide ample support for essential economic and military programs. However, there will continue to be limitations on Soviet scientific resources which will make careful allocation mandatory and circumscribe the number of major programs that the USSR can undertake concurrently, especially in view of the increasing scientific demands within the Bloc as a whole. Soviet military and heavy industrial requirements will probably continue to be the primary factors influencing scientific

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planning and allocations of technical resources, although increased attention will probably be given to the application of science to agriculture.

53. At present the scientific assets of the USSR (the number and quality of trained personnel, facilities, and equipment) are smaller than those of the US, and the assets of the Sino-Soviet Bloc are far smaller than those of the West. Soviet financial support for science, while increasing, remains considerably below that of the US, possibly about one-half. However, with respect to scientists of the very top rank, whose numbers are few in any country, the USSR probably has in many fields men who are as able as their counterparts in Western countries. During the period of this estimate the USSR will provide the great bulk of Bloc scientific assets, and its proportionate share will continue to grow. However, East Germany, Czechoslovakia, and to a lesser extent Poland and Hungary, will continue to contribute a substantial increment. On the other hand, Communist China, because of an extreme shortage of scientific and technical manpower and facilities, is unlikely to contribute to Soviet Bloc technical resources during the period of this estimate.

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54. The USSR has a large number of organizations, laboratories, institutes, etc., engaged in research in all fields of science. In general, organizational control and laboratory facilities are sufficient for effective utilization of scientific talent. Important Soviet laboratories conducting high priority research projects are adequately equipped. However, complex research instruments and equipment are somewhat less readily available in the USSR than in the United States or the UK. Consequently, some specialized lower priority research projects are probably delayed longer than similar projects would be in Western nations. Although the USSR continues to import some scientific instruments from Western nations, it is now manufacturing or can obtain within the Bloc practically all types of scientific instruments for laboratory research, and also industrial instruments for plant operations and control. Research and development in electronics will dominate the science of instrumentation within the USSR during the period of this estimate, with emphasis on better recording and controlling instruments.

limited number and types of

55. There is no evidence that Soviet ideology has seriously hampered the development of the physical sciences, especially in applications directly affecting industrial and military capabilities. In

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certain fields of the biological sciences, however, officially sponsored ideological doctrines have probably exerted a retarding influence on research, although the present weakness in these fields is probably due more to the heavy official emphasis laid on other fields of research than to ideological restraints. There are indications that even in the biological field ideological restraints are likely to be of less consequence in the future than they have been in the past.

SCIENTIFIC EDUCATION AND MANPOWER

56. Prior to World War II the general quality of Soviet higher education and research in most scientific and technical fields was markedly below that of the US. In the postwar period, however, it has been generally good, and has approached US standards. Only in some areas of biology, particularly in the agricultural sciences, does it appear that the present quality of Soviet education and research may be decidedly below that of the US. However by 1960, in view of the probable greater emphasis upon agricultural development, this deficiency is likely to be considerably reduced.

57. About 1,560,000 Soviet citizens have scientific or technical degrees from colleges and universities, of whom about 785,000 are postwar

graduates. The number of university or technical institute graduates employed in the scientific-technical field in the USSR (1,240,000) compares closely with that in the US.^{7/} It is estimated that 175,000 scientists are engaged in advanced research or teaching at higher level institutions in the USSR, compared with about 265,000 so engaged in the US. Because of the greater stress on the biological and health sciences, however, the USSR has only an estimated 85,000 in the physical sciences,^{as} compared with about 210,000 in the US. Soviet scientists in research and development in all fields of science (excluding those primarily engaged in teaching) number about 100,000, about one-half of the number similarly occupied in the US. During the period of this estimate the Soviet scientific manpower pool will probably increase considerably more rapidly than that of the US.

58. The USSR is not as well supplied with technicians, mechanics, and maintenance men as are the Western countries, where broader sections of the population have acquired mechanical skills over a considerably longer period. Standards of maintenance for all kinds of mechanized

^{7/} Numerical estimates of Soviet scientific personnel are believed to be correct to within plus or minus 10 percent. For a detailed comparison of USSR and US scientific personnel, see graphics on following page.

equipment are in general lower than in Western countries and rates of deterioration higher. In addition, the number of skilled mechanics and technicians which would be available to the armed forces in war is far smaller than in the West. However, Soviet engineers have sought to compensate for these deficiencies by building machines and equipment which are simple in design and easy to maintain and repair.

SCIENTIFIC AND TECHNICAL DEVELOPMENT OF MILITARY SIGNIFICANCE

59. The capability of Soviet scientists and technicians in those basic scientific fields (e.g., physical sciences, mathematics) which are related to the development and production of weapons and military equipment is sufficient to insure the development of modern arms for Soviet forces. In response to new requirements and conditions created by the application of advance technology to war and war preparations, the USSR appears to be placing great emphasis upon development of new scientific fields and techniques to maximize the return from Soviet resources, both human and non-human (e.g., human engineering, mental conditioning, casualty therapy, computer research, automation).

60. The USSR probably has the scientific and technological capability necessary to develop most weapons and military equipment equivalent

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to, and in a few cases possibly better than, those of other nations. However, in a number of weapons categories, especially those involving new and complex equipment, the USSR lags behind the West. Moreover, the USSR probably does not have sufficient scientific resources to program vigorous weapons and equipment research simultaneously in all fields, and this deficiency, while possibly decreasing, will probably continue through 1960. Nevertheless, Soviet espionage potential, coupled with the free nations' inherent inability to guard their secrets, probably compensates in some degree for deficiencies in the Soviet scientific effort.

Nuclear Weapons

~~8/~~ See following pages

~~(Paragraphs to be inserted)~~

~~8/ For a fuller treatment of this subject see NIE - (JAEIC estimate).~~

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Nuclear Weapons ^{1/}

60a. The Soviet atomic energy program, directed primarily toward the production of nuclear weapons, will continue to receive special emphasis through 1958. The USSR had tested by the end of 1953, small and medium yield weapons and has employed thermonuclear boosting principles to produce an energy yield up to 1,000 kilotons of TNT. The 1954 test series showed stockpile types in the medium yield range and extensive development in the small yield ranges, but there was no further development in the large yield range. During the immediate future, the types of weapons stockpiled will probably have the general characteristics and explosive powers of weapons already tested although the quantity of the large yield type that could be produced would probably be limited. Within the limits of technological capabilities as of the end of 1954, Soviet military requirements will govern the allocation of available fissionable material to various types of weapons, with consideration probably being given

^{1/} See NIE 11-2-55, "The Soviet Atomic Energy Program," Restricted Data, dated 25 April 1955 for details of Soviet nuclear energy program.

more to operational requirements than to the largest total energy yield attainable.

60b. In order to provide an example of Soviet stockpile capabilities, we have assumed that: (1) one-third of estimated uranium-235 is utilized in large yield weapons (500 to 1,000 KT); (2) two-thirds is utilized in medium-yield (70 KT) composite weapons; and (3) the remaining plutonium is divided equally between medium-yield (40 KT) and small-yield (5 KT) weapons. For purposes of comparison this allocation of fissionable material is carried through mid-1958. If the Soviet stockpile were allocated in this manner it would be as follows:^{1/}

	<u>Mid-1955</u>	<u>Mid-1958</u>
Large-yield weapons (500-1,000 KT)	15	50
Medium-yield weapons (40-70 KT)	320	950
Small-yield weapons (5 KT)	155	250

60c. However, due to continued Soviet nuclear progress, other allocations of fissionable material might become more

^{1/} In view of the range of error applicable to the estimate of Soviet fissionable material production, the actual figures for the end of 1955 may be as much as one-third lower or higher than the figures given above. Uncertainty increases as estimates are projected into the future and the actual figure for mid-1958 may be as low as one-half or as high as twice the figures given in the table.

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likely toward mid-1958. The USSR will probably continue work on larger yield weapons as well as on smaller-yield and small-dimension weapons. We estimate that by mid-1956 the USSR could have weapons with ranges of yields from 0.5 KT to 10,000 KT or more. Such developments would permit more flexibility in the use of nuclear weapons. Assuming such progress on the part of the Soviets, one of the ways in which their 1958 weapons stockpile could be divided would be as follows:

Large-yield weapons (500 to 10,000 KT)	230
Medium-yield weapons (5 to 500 KT)	440
Small-yield weapons (0.5 to 5 KT)	570

60d. Longer-range extrapolations can be carried out on the basis of assumptions of the growth pattern the Soviet nuclear program could follow during the period in question. Alternate assumptions, which indicate a range of growth capabilities, are:

(1) No expansion of Soviet fissionable materials production facilities after 1958 (Assumption A); or,

(2) Continued expansion of Soviet fissionable materials production facilities after 1958 at the same rate as estimates for the period 1949 to mid-1958 (Assumption B); or,

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(3) Expansion of the Soviet program after 1958 at a rate which will increase its requirements for uranium to approximately 7,000 to 10,000 tons per year by 1964 (Assumption C).

60e. In view of the broad spectrum of weapon types which will probably be available to the USSR, it becomes increasingly difficult to make specific estimates of the detailed make-up of the Soviet stockpile as it is projected into the future. The following example of a possible Soviet weapon stockpile will indicate the general magnitude of the Soviet capability under each of the three assumptions given above.

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TABLE

EXAMPLES OF POSSIBLE SOVIET NUCLEAR WEAPONS STOCKPILES - 1959-1960

<u>Assumption A</u>	<u>Mid</u> <u>1959</u>	<u>Mid</u> <u>1960</u>
Large Yield Weapons (500-10,000 KT or more)	280	340
Intermediate Yield Weapons (5 - 500 KT)	550	660
Small Yield Weapons (0.5 - 5 KT)	710	850
 <u>Assumption B</u>		
Large Yield Weapons (500-10,000 KT or more)	290	360
Intermediate Yield Weapons (5 - 500 KT)	560	700
Small Yield Weapons (0.5 - 5 KT)	720	900
 <u>Assumption C</u>		
Large Yield Weapons (500-10,000 KT or more)	320	450
Intermediate Yield Weapons (5 - 500 KT)	630	880
Small Yield Weapons (0.5 - 5 KT)	810	1130

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60f. There is no direct information on the nature of the Soviet control organization and facilities for storage, handling, and distribution of nuclear weapons. However, we believe that Soviet nuclear weapons will be handled by a special organization within the Ministry of Defense and will be stored at both a few large reserve-stockpile storage sites and a large number of smaller sites. These small sites will probably be located at or near airfields, guided missile sites, and other delivery vehicle installations in advanced areas.

60g. Radiological Warfare. It is most unlikely, for technological reasons, that the USSR will be able to stockpile militarily significant quantities of radiological warfare weapons during the period of this estimate. However, the significance of radio-active fall-out following large nuclear explosions should be considered in connection with Soviet capabilities to produce explosions in the megaton range.

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Guided Missiles 2/

61. We believe that the strategic requirements of the USSR would dictate a major effort in the field of guided missiles, and the evidence which we have concerning the large number of personalities and activities believed to be involved in the current Soviet missile program leads us to the conclusion that it is a large one. On the basis of our extensive knowledge of Soviet exploitation of the wartime German missile experience and our estimate of Soviet capabilities in related fields, we believe that the USSR has the basic scientific and technical capabilities to support a comprehensive missile research and development program. The USSR also has an adequate economic base for a sizeable production program. It is probable that the USSR now has some guided missiles in operational status, and that a growing Soviet guided missile ^{capability} ~~threat~~ will develop within the next several years. However, we have no firm current intelligence on what particular types of missiles the USSR is presently developing, or may now have in operational use.

2/ For a discussion of Soviet guided missiles, including estimates of the dates at which various types of missiles might appear in Soviet operational use, see NIE 11-6-54: "Soviet Capabilities and Probable Programs in the Guided Missile Field," published 5 October 1954. No evidence has appeared, since the publication of that estimate, which justifies a change in its conclusions.

Electronics and Communications

62. The USSR has made substantial progress toward catching up with the West in electronics by expanding its manufacturing facilities and adapting Western equipment. The magnitude, diversity, and past successes of the Soviet research and development program in electronics indicate the probable development of new and improved devices. Air defense capabilities will probably be improved as a consequence of significant advances in detection, warning, interception, and data-handling equipment, which are expected during the period of this estimate. Those aspects of communication theory which have a direct bearing on communication techniques, radar, computers, automatic guidance devices, and telemetering are under continuing study by Soviet scientists. Such research will result in practical applications and may within the period of this estimate lead to a communication network exceedingly difficult to intercept or jam. During the period of this estimate the USSR will improve its electronics capabilities in the following categories.

63. Early Warning Radar (EW) - The USSR has a large variety of EW radars in use. These include World War II sets, native sets based on Western designs, and sets of purely native design. Most of these will continue in use through 1956 and will afford fairly reliable coverage against

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maximum ranges from medium bombers at 125 miles (up to 60,000 feet altitude) to 180 miles (up to 45,000 feet altitude). Against fighters these maximum ranges are from 85 miles (up to 45,000 feet altitude) to 135 miles (up to 30,000 feet altitude). Continued use of low-frequency radars (in the 72 mc/s region) through 1958 is indicated. By 1958 the USSR will probably have developed one or more EW radars capable of detecting an object the size of a medium bomber at 60,000 feet up to a distance of about 200 nautical miles. The problem of low altitude coverage will still exist but probably will be greatly lessened by the use of moving target indicators and gap-filler radars. By 1960 the performance of the early warning radar estimated to be introduced in 1958 will probably be increased somewhat.

64. Ground Control Intercept Radar (GCI) - We estimate that by 1958 the USSR will have GCI radars of several types, including the V-beam sets presently in use, which should be capable of coverage on medium bombers at maximum reliable ranges of 150-200 nautical miles and on fighters at maximum reliable ranges of 55-85 nautical miles, depending on altitude, location, and other factors. More recent than the excellent V-beam sets are the paired combinations of long-range azimuth indicating sets (GAGE) and height indicating sets (PATTY CAKE), which collectively

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can provide GCI data. We believe that by 1960 GCI coverage will be increased to the order of 200 nautical miles; this will necessitate the use of transponder beacons in interceptor aircraft. Maximum reliable altitude coverage up to 60,000 feet, though at less than maximum ranges, will be achieved by 1959.

65. Airborne Intercept Radar - There is confirmed evidence that the USSR now has airborne intercept radar, in at least limited operational use in widely separated geographic areas. The equipment is probably comparable to existing Western types. It can probably be ^{installed} placed on current types of Soviet fighter aircraft. Within the period of this estimate the Soviet air defense system will probably have improved AI radar in general operational use.

66. Fire Control Radar - The WHIFF radar, the Soviet version of the SCR-584, will almost certainly continue to be used in quantity. Meanwhile, development work on radar sets with greater accuracies, range definitions, and reduced vulnerability to jamming will proceed during the period of this estimate, and ^{new sets} might appear at any time. The X-band probably will be used for newly developed fire control radars.

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67. Blind Bombing and Navigational Radar - The USSR currently has in operational use an X-band (three centimeter) set developed in the post-war period and capable of further improvement. By the end of 1957, the best Soviet blind bombing and navigational radar should be capable of operating at altitudes up to 50,000 feet and should have a range of about 125 nautical miles for navigation. Bombing and navigation equipment will permit accuracies equivalent to those of present US equipment. The use of frequencies higher than X-band is unlikely by mid-1956, but operational use of the higher frequency equipment may be achieved by mid-1960.

68. Electromagnetic Warfare - The USSR presently has the capability of seriously disrupting Western long-range communications and navigational systems. Soviet achievements in related electronic fields indicate that the USSR is also able, by an intensive effort, to develop electronic jamming equipment which could be effective up through 12,000 megacycles and possibly through 46,000 megacycles. It is estimated that by 1960 the USSR can have jamming equipment in operational use in frequency ranges up through 30,000 megacycles.

69. Microwave Radio - Microwave communication equipment is in wide use in East Germany, and fixed networks exist in the Soviet Union.

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Based on the reported procurement of microwave relay equipment from both East Germany and Hungary, the present inventory of the Soviet Bloc is estimated at approximately 3,000 sets. By 1960, mobile microwave sets of eight channels will probably be standard military issue to divisions and higher echelons. VHF equipment for ground-air, ship-ship, and ship-shore communication, already in use, will find more widespread use with increased numbers of channels and improved reliability. Techniques such as "flash" transmissions will be used to transmit important messages with a minimum susceptibility to countermeasures and maximum of message security.

Biological Warfare

70. Firm evidence on Soviet activity in the biological warfare field is exceedingly scanty, and is likely to remain so because of the relative ease with which such a program can be concealed. The USSR has, however, the technical knowledge, trained personnel, and facilities necessary for a program of research and development in biological warfare, and such a program is probably in progress. The USSR is capable of producing BW agents and disseminating devices suitable for small-scale clandestine attacks against certain crops, against livestock, and against personnel in buildings or concentrated in relatively small areas. Soviet capabilities for large-scale attacks are more difficult to estimate. Antilivestock BW against the US need not be large-scale to be effective.

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Anticrop BW against the US would probably not substantially affect US crop production unless carried out on a very large scale and under favorable seasonal and environmental conditions. The USSR is probably capable of large-scale production of antipersonnel BW weapons.

71. Soviet capabilities for defense against BW are inferior to those of the US because of Soviet deficiencies in public health, sanitation, livestock management, and plant protection. Gradual progress will probably be made to correct these deficiencies during the period of the estimate. Because widespread shipment of livestock is not practiced in the USSR, Soviet vulnerability to small-scale antilivestock attacks is probably less than that of the United States.

Chemical Weapons

72. During World War II, the Soviet Union is known to have produced most of the standard chemical warfare agents as well as the necessary auxiliary equipment. The USSR has the facilities and scientific knowledge necessary to produce at least one of the nerve gases and could employ these agents during the period of this estimate. Published Soviet research

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in fields closely allied to chemical warfare -- organophosphorus chemistry, aerosol formation, cholinesterase, alkaloids, and adsorption -- indicates a scientific capability for the development of new or improved chemical agents, dissemination equipment, and protective devices. We assume that the stockpile of standard agents and munitions accumulated during World War II has been maintained and that the facilities for CW agents production are being maintained on a standby basis or operated to produce other chemicals or materiel. The USSR is able to engage in chemical warfare on a large scale.

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